

**CLAIMS**

1. A periodic electromagnetic structure (20) comprising an array of conducting LC elements (22;22a,22b;42;52;68) in superposition with a frequency-dependent dielectric (30;44;54;70) whose permittivity and/or permeability varies according to the frequency of radiation incident thereon such that the resonant frequency of the LC elements follows the frequency of the incident radiation.
2. The structure of claim 1, wherein the frequency-dependent dielectric has a response to incident radiation such that the product of the permittivity and permeability of the dielectric varies in proportion to the reciprocal of the square of the frequency of the incident radiation.
3. The structure of claims 1 or 2, wherein the LC elements are protrusions (22;22a,22b) from a flat conducting plate (24).
4. The structure of claim 3, wherein the frequency-dependent dielectric abuts the conducting plate and the protrusions extend at least partially into the dielectric.
5. The structure of claim 4, wherein the protrusions are generally thumb tack shaped.
6. The structure of claim 2, wherein the structure forms an ultra compact photonic bandgap device (40).
7. The structure of claim 2, wherein the structure forms a split ring resonator (50).

8. The structure of claim 6 or claim 7, wherein the LC elements are disposed across the surface (43;53) of the frequency-dependent dielectric.
- 5 9. The structure of claim 2, wherein the structure comprises chiral conductors (68).
10. The structure of claim 9, wherein the chiral conductors are helical.
- 10 11. The structure of claim 9 or claim 10, wherein the chiral conductors are set within the frequency dependent dielectric (70).
12. The structure of any preceding claim, wherein the structure forms a high-impedance surface.
- 15 13. The structure of claim 12, wherein the surface impedance of the periodic electromagnetic structure is substantially  $377 \Omega$ .
14. The structure of any preceding claim, wherein the frequency-dependent dielectric is ferrite material type 4E1.
- 20 15. An antenna comprising a periodic electromagnetic structure according to any preceding claim.
- 25 16. A mobile phone handset comprising an antenna according to claim 15.

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17. A radar absorbent material comprising a periodic electromagnetic structure according to any of claims 1 to 14, wherein the impedance of the structure is substantially  $377 \Omega$ , thereby to match the impedance of free space.
- 5 18. A periodic electromagnetic structure as substantially described hereinbefore with reference to Figure 3, Figure 4, Figure 5, Figure 9 or any of Figures 6 to 8.